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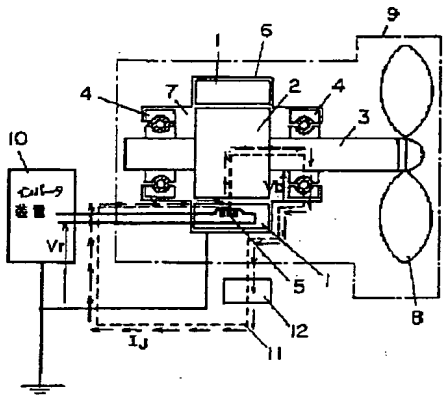
(54) BEARING PROTECTION DEVICE FOR BLOWER

(57) Abstract:

PROBLEM TO BE SOLVED: To reduce or eliminate damage caused by electrocorrosion of a bearing due to shaft current while using a usual motor without providing a special means to a motor body in a blower driven by an inverter device.

SOLUTION: Discharge or energization is performed through an oil film between a shaft 3 and a bearing 4 using a ripple voltage Vr generated between a stator winding 5 of a motor and ground as a power source and a shaft current Ij flowing to the bearing 4 is reduced or eliminated by arranging a means 12 for reducing or eliminating the shaft current Ij to a closed circuit 11 to the shaft current Ij flowing to the bearing 4. Thereby, it is possible to obtain effect to reduce or eliminate damage caused by electrocorrosion of the bearing 4 due to the shaft current Ij while using a usual motor without providing a special means to a motor body.



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[Title of the Invention] Bearing Protective Device for Blower

[Abstract]

[Object] An object of the present invention is that in a blower driven by an inverter device, the damage to a bearing due to electrolytic corrosion caused by a shaft current is reduced or eliminated while an ordinary electric motor is used without providing special means on the electric motor body.

[Constitution] A ripple voltage Vr generated between a stator winding 5 of an electric motor and the ground is used as a power source, electricity is discharged or allowed to flow through an oil film between a shaft 3 and a bearing 4, and a means 12 for reducing or eliminating the shaft current Ij is arranged in a closed circuit, whereby the shaft current Ij flowing in the bearing 4 is reduced or eliminated. Thereby, an effect of reducing or eliminating the damage to the bearing 4 due to electrolytic corrosion caused by the shaft current Ij can be achieved while an ordinary electric motor is used without providing special means on the electric motor body.

[Claims for the Patent]

[Claim 1]

A bearing protective device for a blower, characterized in that in a blower which is formed by an electric motor and a blade and is driven by an inverter device which supplies a voltage, in which a pulse width is modulated, to a stator winding of the electric motor, and the chassis of which is grounded, the electric motor being formed by a shaft penetrating a rotor paired with a stator iron core, a bearing for rotatably supporting the shaft, and the stator winding, and a frame that supports the stator iron core and the outer race of the bearing and is connected electrically being grounded, an electrically closed circuit formed between the electric motor, the inverter device, and a ground is provided, and a means for reducing or eliminating a shaft current flowing in the bearing in this closed circuit is provided.

[Claim 2]

The bearing protective device for a blower according to claim 1, characterized in that as a means for reducing or eliminating the shaft current, a means for reducing or eliminating the shaft current generated between the shaft and the ground via the bearing is provided in the electrically closed circuit formed between the electric motor, the inverter device, and the ground.

[Claim 3]

The bearing protective device for a blower according to

claim 1, characterized in that as a means for reducing or eliminating the shaft current, a filter circuit having an impedance designed so as to reduce the shaft current corresponding to a frequency of the shaft current is provided in series in the electrically closed circuit formed between the electric motor, the inverter device, and the ground.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to a bearing protective device for a blower in the blower driven by an inverter device.

[0002]

[Prior Art]

In recent years, in the method for driving a blower, a method in which the rotational speed of blade is regulated by using an inverter device has been used mainly.

[0003]

However, in the case where an electric motor is driven by using the inverter device, a voltage called a shaft voltage is produced between the shaft and the ground via the bearing of the electric motor, electricity being discharged or allowed to flow through an oil film between the shaft and the bearing, and a current called a shaft current flows, which presents a problem in that the bearing is damaged by electrolytic corrosion.

[0004]

Conventionally, as the bearing protective device of this type, a bearing protective device described in Japanese Patent Unexamined Publication No. 61-224836 has been known.

[0005]

Hereunder, this bearing protective device is explained with reference to Figure 5. In the method shown in Figure 5, an insulating material 104 is disposed between the outer race of a bearing 102 fixed to a shaft 101 and a frame 103 of a grounded electric motor, and an electrically closed circuit of a ripple current Vr generated between a stator winding 105 and the ground is opened, by which a shaft current Ij flowing to the bearing 102 is eliminated to prevent the electrolytic corrosion of the bearing 102.

[0006]

Also, as a method for reducing the shaft current, for example, a method in which the switching speed of a switching device of the inverter device is decreased has been known.

[0007]

[Problems to be Solved by the Invention]

However, the above-described conventional methods have some problems.

[0008]

First, since the electric motor is a special electric motor provided with measures against shaft current, in the case where the bearing is damaged by the shaft current at

the site at which a plurality of electric motors have already operated, total numbers of electric motors must be replaced with specific electric motors provided with measures against shaft current, which requires an enormous cost.

[0009]

Also, since the insulating material is disposed between the outer race of bearing and the frame of electric motor, the construction is complicated, and it is difficult to adjust fitting dimensions at the time of production in factory.

[0010]

Also, since the bearing portion has a very high temperature, the insulating material has a problem of lower durability. Also, if the method in which the switching speed of the switching device of the inverter device is decreased is used as a method for reducing the shaft current, the carrier frequency that controls the mode of output voltage, in which the pulse width is modulated, of the inverter device must be reduced. At this time, if the carrier frequency is reduced from several tens kilohertz to several kilohertz, harsh noise of a high note is generated in the operation sound of electric motor, so that such a method cannot be used as a method for driving the electric motor for a blower that is used as air-conditioning equipment for a space in which people gather.

[0011]

The present invention has been made to solve the above-mentioned conventional problems, and accordingly an object thereof is to provide a bearing protective device for a blower which is capable of eliminating the damage to bearing caused by a shaft current at a carrier frequency of output voltage of an inverter device of several tens kilohertz while an ordinary electric motor is used without providing special means on the electric motor body.

[0012]

[Means for Solving the Problems]

To achieve the above object, the bearing protective device for a blower in accordance with the present invention is configured so that a means for reducing or eliminating the shaft current flowing in the bearing is provided in an electrically closed circuit formed between the electric motor, the inverter device, and the ground.

[0013]

According to the present invention, by reducing or eliminating the shaft current flowing in the bearing, a bearing protective device for a blower, which can eliminate the damage to bearing caused by the shaft current at a carrier frequency of output voltage of an inverter device of several tens kilohertz while an ordinary electric motor is used without providing special means on the electric motor body, can be obtained.

[0014]

[Embodiments of the Invention]

The invention described in claim 1 of the present invention includes a blower which is formed by an electric motor and a blade, the electric motor being formed by a shaft penetrating a rotor paired with a stator iron core, a pair of bearings for rotatably supporting the shaft, and a stator winding, an inverter device which supplies a voltage, in which a pulse width is modulated, to the stator winding of the electric motor, and the chassis of which is grounded, an electrically closed circuit formed between the electric motor, the inverter device, and the ground, and a means for reducing or eliminating a shaft current flowing in the bearings in the closed circuit, which is provided in the closed circuit, and has action of eliminating the damage to bearings due to electrolytic corrosion by reducing or eliminating the shaft current flowing in the bearings.

[0015]

Examples of the present invention will now be described with reference to the accompanying drawings.

[0016]

[Examples]

(Example 1) Figure 1 is a configuration view of example 1 of the present invention, and Figure 2 is a circuit diagram therefor. In Figure 1, a blower 9 formed by an electric motor 7 and a blade 8 is driven by an inverter device 10 which supplies a voltage, in which the pulse width is modulated, to a stator winding 5 of the electric motor 7, and the chassis of which is grounded. The electric motor 7

is formed by a shaft 3 penetrating a rotor 2 paired with a stator iron core 1, a pair of bearings 4 for rotatably supporting the shaft 3, and the stator winding 5, and a frame 6 that supports the stator iron core 1 and the outer races of the bearings 4 and is connected electrically is grounded. At this time, an electrically closed circuit 11 is formed between the electric motor 7, the inverter device 10, and the ground. If a ripple voltage Vr is generated between the stator winding 5 and the ground in this closed circuit 11, a shaft voltage Vb is divided between the shaft 3 and the ground via the bearing 4 by electrostatic induction of the closed circuit 11. Here, the generation principle of the shaft voltage Vb is shown using Figure 2. If the ripple voltage Vr exists between the stator winding 5 and the ground, this voltage is divided by a capacitance Cw of the stator winding 5 and the shaft 3 and a capacitance Cb of an oil film between the shaft 3 and the bearing 4, the bearing 4, and the grounded motor frame 6. The sharing voltage of the capacitance Cb is expressed by Equation (1).

$$Vb = Vr \times Cw / (Cw + Cb) \quad \ldots (1)$$

This sharing voltage is generated between the shaft 3 and the ground via the bearing 4 as the shaft voltage Vb. If the shaft voltage Vb exceeds a standard value, electricity is discharged or allowed to flow through the oil film between the shaft 3 and the bearing 4, and a current called a shaft current Ij flows in the bearing 4. Therefore, a means 12 for reducing or eliminating the shaft current Ij is

disposed in the closed circuit 11, by which the shaft current Ij flowing in the bearing 4 can be reduced or eliminated.

[0017]

(Example 2) Figure 3 is a configuration view of example 2 of the present invention. In Figure 3, as a means for reducing or eliminating the shaft current Ij, a means 12a for reducing or eliminating the shaft voltage, which is formed by a resistor 13 and a capacitor 14, is disposed in the electrically closed circuit 11 formed between the electric motor 7, the inverter device 10, and the ground so as to be electrically in parallel with a grinding wire 15 of the electric motor 7.

[0018]

When the electric motor 7 is operated, electric charges 18 that correspond to and are opposite to electric charges 17 generated in the rotor 2 are accumulated in the stator iron core 1. Therefore, by removing the electric charges 18 accumulated in the stator iron core 1, the electric charges 17 generated in the rotor 2 are removed, so that the shaft voltage Vb generated between the shaft 3 penetrating the rotor 2 via the bearings 4 and the ground can be reduced. In order to remove the electric charges 18 accumulated in the stator iron core 1, the electric charges 18 in the stator iron core 1 is absorbed by the capacitor 14 through the resistor 13 of the means 12a for reducing or eliminating the shaft voltage from the frame 6 electrically and

mechanically connected to the stator iron core 1. The resistance value R1 of the resistor 13 in this case satisfies the relationship expressed by Equation (2) by being compared with the resistance value R0 of the grounding wire 15, the resistance value R1 being a limit resistance in the case where the capacitor 14 is charged.

[0019]

$$R0 \gg R1 \qquad \ldots (2)$$

Also, for the capacitor 14, at the time of high frequency in Equation (3), a low impedance can be provided, so that the impedance is considerably lower than that of the grounding wire 15. As a result, the electric charges 18 generated in the stator iron core 1 are stored in the capacitor 14, and are discharged via the resistor 13 before the next electric charges 18 are generated in the stator iron core 1.

[0020]

$$Z = 1 / (2\pi fc) \qquad \ldots (3)$$

Z ... impedance

f ... switching frequency generated in inverter

c ... capacity of capacitor

The switching frequency generated in the inverter 10 is several megahertz.

[0021]

(Example 3) Figure 4 is a configuration view of example 3 of the present invention. In Figure 4, in the electrically closed circuit 11 formed between the electric motor 7, the

inverter device 10, and the ground, as a means for reducing or eliminating the shaft current Ij, a filter circuit 12b designed to an impedance having a frequency characteristics corresponding to the frequency of the shaft current Ij is arranged in series, by which the shaft current Ij is reduced or eliminated.

[0022]

[Effect of the Invention]

As described above, according to the present invention, the shaft current can be reduced or eliminated while an ordinary electric motor is used without providing special means on the electric motor body, by which an advantageous effect of reducing or eliminating the damage to bearing caused by electrolytic corrosion can be achieved.

[Brief Description of the Drawings]

[Figure 1] A configuration view showing a bearing protective device for a blower in accordance with example 1 of the present invention.

[Figure 2] A circuit diagram of the bearing protective device for a blower shown in Figure 1.

[Figure 3] A configuration view showing a bearing protective device for a blower in accordance with example 2.

[Figure 4] A configuration view showing a bearing protective device for a blower in accordance with example 3.

[Figure 5] A configuration view showing a conventional bearing protective device for a blower.

[Explanation of Reference Numerals]

1 stator iron core

2 rotor

3 shaft

4 bearing

5 stator winding

6 frame

7 electric motor

8 blade

9 blower

10 inverter device

11 closed circuit

12 means for reducing or eliminating shaft current

[Figure 1]

1 stator iron core

2 rotor

3 shaft

4 bearing

5 stator winding

6 frame

7 electric motor

8 blade

9 blower

11 closed circuit

12 means for reducing or eliminating shaft current

Vr ripple voltage

Vb shaft voltage

[Figure 2]

Cw capacitance of the stator winding 5 and the shaft 3

Cb a capacitance of the shaft 3 and the earth

[Figure 3]

12a means for reducing or eliminating shaft current

13 resistor

14 capacitor

15 grinding wire

17 electric charges generated in the rotor 2

18 electric charges generated in the stator iron core

[Figure 4]

12b filter circuit

10 inverter device

[Figure 5]

stator